

Relativity: Re-visiting The Cosmos

DiPs at *The Blue Mugge* pub, Mon 29th February 2016

There was a young fellow named Bright,
Whose speed was much faster than light.
He departed one day, in a relative way,
And arrived back the previous night!!

Introduction: The twin Theories of Relativity - Special Relativity and General Relativity - sprang from the imagination of Albert Einstein. They appear to be the best currently available views of the Cosmos. Let's see if the collective imaginations of our minds grasp what Einstein discovered?

For those who like to learn some background by listening, here is an *In Our Time* discussion on Relativity: <http://www.bbc.co.uk/programmes/b02144gl>

If you like to learn by watching, here are two short videos:

- on Special Relativity <https://www.youtube.com/watch?v=TgH9KXEQ0YU> and
- on General Relativity <https://www.youtube.com/watch?v=fEZupmpTcOU>

For those who like to learn by reading, here is a link to Carlo Rovelli's tiny book '*Seven Brief Lessons in Physics*', which outsold '*50 Shades of Grey*' on publication in Italy. His even tinier first chapter has been reprinted in *The Independent* <http://www.independent.co.uk/news/science/general-theory-of-relativity-explained-the-beautiful-simplicity-and-weird-time-sags-of-einsteins-100-10494156.html> It is a most beautiful read.

Questions:

1. What do members of our circle know about the speed of light and how, or when, it was measured?

Special Relativity – this only refers to objects travelling at a constant velocity (1905)

2. As you stand on a station platform, how does the sound of the horn change when a train goes past you at speed, say 100mph? Why should that be? What is the relationship between speed, time and distance?
3. The train has its headlight on. As it approaches you, what is the speed of the light as it travels from headlight to your eye? What is the speed of the light as it travels from the receding rear light to your eye? From the point of view of the train driver, who sees another train approaching him at speed, what is the closing speed of light from that train's headlight to the first driver's eye?
4. Now we need to use our collective imaginations. After thinking about 1 – 3, above, what deductions can we make about speed, distance and time, from the different points of view of driver and platform observer? What if you imagine that you are sitting on the light beam?
5. Can we think of any commonly used technology that depends on what we have learned so far?

General Relativity – this applies to objects that are accelerating (1915)

5. Imagine you stand on bathroom scales. What information do you get from the scales? Why?
6. Now imagine that you are in a stationary lift and still standing on bathroom scales. What do you expect will happen to the scales' reading, at the moment when the lift accelerates upwards? And now downwards?
7. Imagine you are still standing on bathroom scales in a stationary lift. Instantly, the cable breaks. The lift, you and the scales are all falling together. Why? What would you expect the scales, which you are still standing on, to read now?
8. We all have an image that "gravity" pulls objects "down", say, to the ground. But what if there is nothing "pulling" objects "down"? Are we making an assumption? Using our circle's collective imagination, can we propose a means by which objects are "pushed down".

The Reaction to General Relativity

9. What can any members of our circle tell us about the early reaction to General Relativity? What or when were the first spectacular experiments that confirmed Einstein's proposals?
10. Finally, what do we know about the implications of General relativity for our understanding of the Cosmos, its beginning and its potential end? How do "gravitational waves" (probable detection of which was reported to media acclaim on 11 & 12 February 2016) fit into all that we have discussed?